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A new fossil geryonid crab (Crustacea: Decapoda: Brachyura) from the late Pliocene to early Pleistocene of Japan

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Abstract.—A new fossil geryonid crab, *Chaceon matsushimai* is described from the uppermost Pliocene to lower Pleistocene Ofuna and Koshiba formations, Kazusa Group in Kamakura and Yokohama cities, central Japan. The new species resembles members of the extant *Chaceon granulatus* species group, but is distinguished by having very faint frontal, second, and fourth anterolateral spines and a proportionately narrower male abdomen. This is the first fossil record of the genus *Chaceon* from Japan.

Recent revisions of deep sea geryonid crabs (Manning & Holthuis 1987, 1989) previously placed in the genus *Geryon* Krøyer, 1837, have shown that species which possess five anterolateral spines on the carapace and four distinct spines on the frontal margin should be referred to the genus *Chaceon* (Manning & Holthuis, 1989). Species of *Geryon* [type species: *Geryon trispinosus* (Herbst, 1803)] have only three anterolateral spines, and less pronounced frontal spines. Based on these carapace features, the new species of fossil described herein is referable to *Chaceon,* which has eight living species in the Pacific Ocean, two of which are found in Japanese waters (Ng & Manning 1998).

Koizumi & Matsushima (1992) first reported fossils of *Geryon* species in association with molluscs and fishes indicative of lower sublittoral to upper bathyal waters from the lower Pleistocene Ofuna Formation, Kazusa Group in Kamakura City (referred to here as the Ofuna specimens). Poorly preserved cyclodorippid crab *Tymolus* species were also obtained from the locality. As noted by these authors, two specimens deposited in the Kanagawa Prefectural Museum of Natural History, which had been collected by Mr. Syozo Aizawa from the overlying Koshiba Formation, are assignable to the same species (here referred to as the Koshiba specimens).

In addition, a fossil specimen in the collection by late Professor Rikizo Imaizumi preserved in the Institute of Geology and Paleontology, Tohoku University, is also identical to the present new species (here referred to as the IGPS specimen). Although this specimen lacks a label and information about the locality, stratigraphic horizon and name of collector, a piece of card belonging to the specimen and probably written by Imaizumi reads "Kamakura". The matrix of this specimen is indistinguishable from those of the Ofuna specimens.

The Ofuna specimens occurred in massive, light gray-colored siltstone exposed in the land-development field for residential construction in Iwase, Kamakura City, Kanagawa Prefecture, central Japan (35°20′58″N, 139°32′51″E). The crab-bearing horizon is stratigraphically situated between the Ny Tuff Bed (Nakaya Tuff bed: same as O26 (Of2) in Mitsunashi & Kikuchi, 1982) and the Is Tuff bed. The former is a remarkable key bed widely traceable in the Yokohama-Kamakura area.

The Koshiba specimens had been obtained from the massive, light gray-colored pumiceous sandy siltstone of the lower part

of the Koshiba Formation exposed in the land-development field in the Seibu-danchi, Nishishiba, Kanazawa-ku, Yokohama City (35°21′N, 139°38′E). They are mostly impressions and/or molds due to compression and weathering.

Mitsunashi & Kikuchi (1982) correlated several remarkable tuff beds in the Ofuna Formation with those in the lower Pleistocene Otadai and Kiwada formations of the Boso Peninsula. Eto et al. (1987) considered the age of the Ofuna Formation to be early Pleistocene based on the planktonic foraminifera (N22 Zone of Blow 1969) and calcareous nannoplankton ("CN12" Zone of Okada and Bukry 1980). However, the calcareous nannoplankton assemblage of the formation identified by them indicates that the age extends into the latest Pliocene (CN13a Zone of Okada & Bukry 1980: Y. Tanaka pers. comm.). Considering these facts, the geologic age of the fossils from the Ofuna and Koshiba formations is most likely to be latest Pliocene to earliest Pleistocene (ca. 1.9–1.7 Ma).

The specimens are deposited in the Kanagawa Museum of Natural History (KPM-NN) and Institute of Geology and Paleontology, Faculty of Science, Tohoku University (IGPS coll. cat. no.). The abbreviations cl and cw indicate carapace length and carapace width.

Family Geryonidae Colosi, 1923

Genus *Chaceon* Manning & Holthuis, 1989

Chaceon matsushimai, new species
Figs. 1–4

Geryon sp.: Koizumi & Matsushima, 1992, p. 127, figs. 8–1–3.

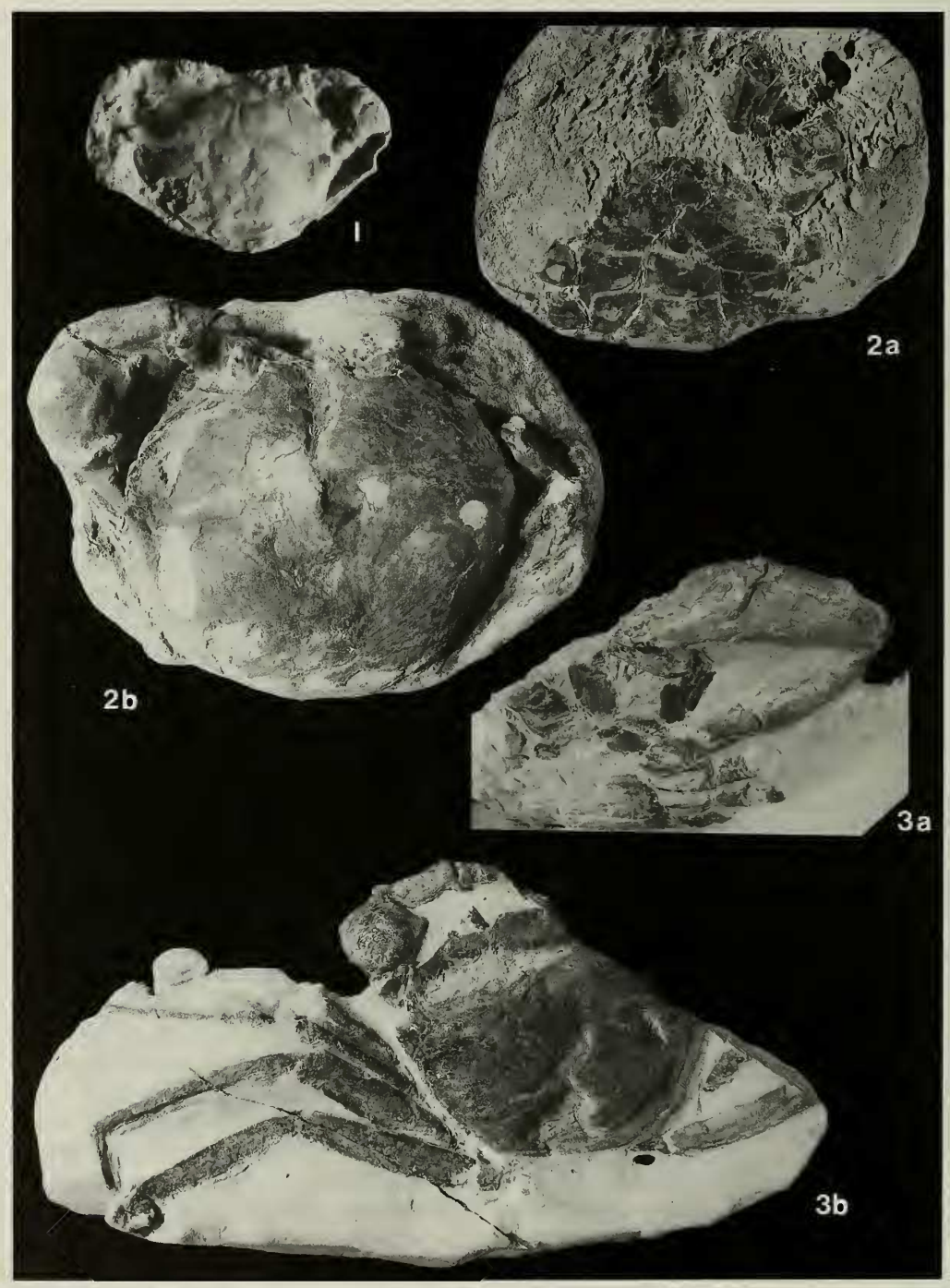
Material examined.—KPM-NN-5941 (holotype; cw 66.0+ mm, ca. 70 mm, cl 55.9 mm), 5942 (cw 15.5+ mm, cl 15.8 mm), 5943 (paratype 2; cw 32.5 mm, cl 24.4 mm), 198A (cw 31.4 mm, cl 28.3 mm), 198B (cw 49+ mm, cl 44+ mm), IGPS coll. cat. no. 103703 (paratype 1; cw 59.0 mm, cl 51.5 mm).

Diagnosis.—Small *Chaceon* with 4 faint projections on frontal margin, and 3 distinct spines and 2 very faint spines or lobes on anterolateral margin. Male abdomen relatively narrow.

Description.—Carapace hexagonal in outline, broader than long. Frontal margin about 0.25 of maximum width with 2 very low medial and 2 lateral lobes. Orbit large; relatively shallow; margin rounded. Anterolateral margin convex with first, third, and fifth spines distinct and second and fourth present as very low spines or lobes. First spine (outer orbital) directed obliquely anteriorly. Second minute spine observed in smaller specimen (paratype 2: Figs. 1, 4a), being indistinct lobe in largest specimen (paratype 1: Figs. 2, 4c). Third spine pointed with broad base. Fourth spine very low with blunt tip. Fifth spine triangular, largest, directed laterally. Distance from first to third spines slightly shorter than that from third to fifth. Dorsal surface moderately convex; rugose, granulated in posterior half of large specimen (Figs. 2, 3). Branchial region sparsely granulated. Sparse granules on protogastric, mesogastric, and cardiac regions. Regions divided by shallow depressions. Weakly developed transverse ridge extends from branchiocardiac groove to fifth anterolateral spine. In smallest specimen (KPM-NN-5942), however, dorsal regions well divided by deep grooves; proto-, meso- and metagastric, cardiac and branchial regions convex; an arched convex, well demarcated ridge extends from branchiocardiac groove to fifth anterolateral spines. Frontal and anterolateral spines of carapace proportionally larger than in other larger specimens.

Male abdomen relatively narrow; fourth segment slightly shorter than fifth; lateral margins of fifth segment almost parallel; telson triangular.

Chelipeds nearly equal in size. Upper surface of merus with small subdistal spine; carpus with strong inner distal spine. Palm



Figs. 1–3. *Chaceon matsushimai,* new species. 1, Paratype 2, KPM-NN-5943, carapace, ×1.0; 2, Paratype 1, IGPS coll. cat. no. 103703, ×1.0, 2a, thoracic sternites and abdominal somites, 2b, carapace and cheliped; 3, Holotype, KPM-NN-5941, 3a, left cheliped, ventral view, ×0.7, 3b, left cheliped, pereiopods and carapace, ×1.0.

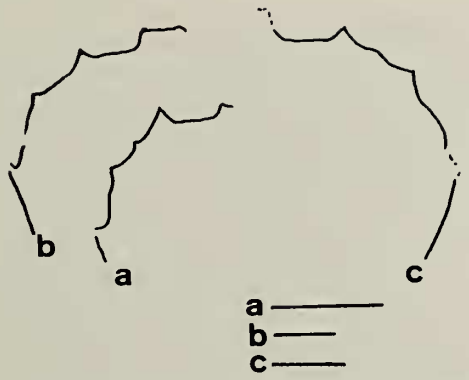


Fig. 4. *Chaceon matsushimai,* new species. Frontorbital and anterolateral margins. a, paratype 2; b, holotype; c, paratype 1. Scales: 1 cm.

sparsely granulated on outer and upper surfaces. Both fingers with strongly serrated occlusal margins; longitudinal furrow and row of pits present on outer surface.

Ambulatory legs long; dactyli dorsoventrally compressed, slightly curved downward.

Etymology.—In honor of Dr. Yoshiaki Matsushima of the Kanagawa Prefectural Museum of Natural History who has made great contributions to the geology and paleontology of the Kanto region as well as to Quaternary molluscan paleontology and paleoecology.

Remarks.—The present new species most closely resembles members of the living *Chaceon granulatus* species group, viz. *C. granulatus* (Sakai, 1978), *C. manningi* Ng et al., 1994, *C. karubar* Manning, 1993, and *C. micronesicus* Ng & Manning, 1998, in having granulose branchial region, very low second and fourth anterolateral spines, and dorsoventrally flattened dactyli of ambulatory legs. In addition to the small adult size, however, *Chaceon matsushimai* is easily distinguished from these living species by having very faintly projected frontal spines, relatively weaker second and fourth anterolateral spines, a broader and shallower orbit and a less granulated carapace. Moreover, the male abdomen, especially the fourth and fifth segments, are proportionately narrower than those of above mentioned living species (see Ng & Manning 1998). The present new species also resembles *Chaceon bicolor* Manning & Holthuis, 1989, from the North and South Pacific Ocean in having lobiform second and fourth anterolateral spines, but is distinguished from that extant species by having dorsoventrally flattened dactyli of ambulatory legs and exhibiting less developed frontal spines.

The general outline of the carapace of the new species resembles those of the genus *Geryon* Krøyer, 1837, in appearance, i.e., frontal spines are very low and the anterolateral margin has very faint second and fourth spines which are sometimes undiscernible, instead of five distinct spines. Although the second spine of the left anterolateral margin is entirely undiscernible in the holotype specimen (Figs. 3, 4b), minute spines or convexities are observed in paratypes 1 and 2 (Figs. 4a, c).

The length/width ratio of the merus of the fifth ambulatory leg of the holotype specimen is 4.3. Due to compression after burial, unfortunately, this value is by no means reliable.

The only known other fossil species of the genus is *Chaceon peruvianus* (d'Orbigny, 1842) from the middle Eocene of Argentina, which was recently transferred from the extinct genus *Archaeogeryon* Colosi, 1923 (Schweitzer & Feldmann 2000).

The fossil species of the genus *Geryon* had hitherto been restricted to the Miocene to Pliocene of Europe-Tethys region (see Dawson & Webber 1991). Other records of fossil Geryonidae are the extinct genera *Archaeogeryon* Colosi, 1923, *Coeloma* A. Milne-Edwards, 1865 and *Archaeoplax* Stimpson, 1863 (Glaessner 1969). *Archaeogeryon* was known from the Miocene of South America (Glaessner 1969, Morris, 1980; the geologic age may have to be reassigned, see Schweitzer & Feldmann 2000). *Archaeoplax* has been reported from the Miocene of North America (Rathbun 1935). Although *Coeloma* has been report-

ed from the Eocene to Oligocene rocks of Europe and North America, the placement within the Geryonidae is still uncertain because it differs considerably from the living species of Geryonidae in morphology of the dorsal carapace (Schweitzer & Feldmann 2000).

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